Submitted to:

The Virginia Department of Environmental Quality

Blue Ridge Regional DEQ Office
MS4 Stormwater Permitting Div.
901 Russell Drive
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CITY OF ROANOKE

MS4 Permit
2018-2023

Revised:
4/1/2020

PCB TMDL ACTION PLAN

Stormwater Utility
Public Works Service Center
1802 Courtland Road, NE
Roanoke, VA 24012

City of Roanoke

POLYCHLORINATED BIPHENYLS (PCB) TMDL ACTION PLAN

INTRODUCTION

In December 2009, a Polychlorinated Biphenyls (PCB) TMDL was established for the Roanoke River. Within the City of Roanoke, the Roanoke River and three of its tributaries, Masons Creek, Peters Creek and Tinker Creek were found to be contaminated for PCBs; thus failing to meet their designated uses under Section 303(d) of the Clean Water Act and the Virginia Water Quality Monitoring, Information, and Restoration Act.

Water quality standards designate a waterbody's uses. In Virginia, the designated uses for surface water bodies are: aquatic life, fish consumption, public water supplies (where applicable), recreation (swimming), shell fishing, and wildlife. If a water body is too polluted to meet its designated uses, it is listed as an impaired stream on the 303(d) list. A TMDL study is then conducted to create a pollution limit. A TMDL or total maximum daily load is established to define the limit of a pollutant that a water body can receive and process while still maintaining health for its designated uses. Due to the fact that PCBs bioaccummulate in fish tissue, the TMDL endpoints were established at 390 ppq to protect fish for human consumption and are more stringent than 1700pg/L (1700 ppq) which was the state required for human health at the time of the TMDL study (Tetra Tech, 2009). VA DEQ's Water Quality Criterion has since been set to 640 ppq.

The Environmental Protection Agency contracted Tetra Tech to conduct a TMDL study which can be sourced from the information box below. The study identifies sources of PCB, impaired stream segments, and determines the reductions needed to achieve acceptable water quality standards. The TMDL study divides the Roanoke River into two segments: the Upper Roanoke River (29 miles in length) and the lower Roanoke or Staunton River (96 miles). The City of Roanoke is under mandate to develop and implement strategies that will positively influence PCB concentrations. This action plan will focus specifically on the City of Roanoke's jurisdictional limits and the associated watersheds and impaired streams. The background information and steps outlined in this Action Plan illustrate the City's compliance and stewardship commitment.

Tetra Tech, Inc. (December 2009). *Roanoke River PCB TMDL Development*. United States Environmental Protection Agency, Region 3. Retrieved from: http://www.deq.virginia.gov/portals/0/DEQ/Water/TMDL/apptmdls/roankrvr/roanokepcb.pdf.

REGULATORY FRAMEWORK

In 2001, PCB's were banned globally by the Stockholm Convention on Persistent Organic Pollutants.

In the United States, PCBs are regulated through the Toxic Substances Control Act (TSCA). TSCA oversees the production, importation, use, and disposal of regulated chemicals released into the environment. Under (5) (TSCA), the term ''environment'' includes water, air, and land and the interrelationship which exists among and between water, air, and land and all living things.

In 1979, under TSCA, it became illegal to manufacture, distribute or use PCBs. Regulations specific for PCBs are found in 40 CFR Section 761.

The TSCA has recently been revised. On June 7, 2016 the US Senate passed the bipartisan House-Senate agreement of the Lautenberg Act. President Obama signed the Frank R. Lautenberg Chemical Safety for the 21st Century Act updating TSCA on June 22, 2016.

The City of Roanoke has the authority to regulate PCBs as illicit discharges per the City Code, Chapter 11.3 Stormwater Discharge Requirements. Relevant sections are outlined below.

Section 11.3-3 defines Illicit discharge as any discharge to the storm sewer system or to the waters of the United States that is not composed entirely of stormwater, except discharges which are exempt pursuant to section 11.3-4(b) of this chapter. Any discharge in violation of a National Pollutant Discharge Elimination System (NPDES) or Virginia Pollutant Discharge Elimination System (VPDES) or other stormwater discharge permit shall constitute an illicit discharge.

Sec. 11.3-4. - Prohibited discharges or connections to the storm sewer system.
(a)(1) Cause or allow any illicit discharges, including but not limited to the discharge of sewage, industrial wastes or other wastes, into the storm sewer system, or any component thereof, or onto driveways, sidewalks, parking lots, or any other areas draining to the storm sewer system.

(a)(4) Discharge any materials or items other than stormwater to the storm sewer system by spill, dumping, or disposal of any type without a valid federal and/or state permit or unless otherwise authorized by law.

Sec. 11.3-5. - Inspections and monitoring.
(a) The director shall have the authority to carry out all inspections and monitoring procedures necessary to determine compliance and/or noncompliance with this chapter, and to enforce this chapter, including the prohibition of illicit discharges to the storm sewer system. The director may monitor stormwater outfalls or other components of the storm sewer system as may be appropriate in the administration and enforcement of this chapter.

Sec. 11.3-6. - Enforcement of chapter and penalties.
(a) Any person who violates any of the provisions of this chapter shall be guilty of a Class I misdemeanor and upon conviction is subject to punishment by a fine of not more than two thousand five hundred dollars ($2,500.00) per violation per day and confinement in jail for not more than twelve (12) months, either or both.

(c) Any person who commits any of the acts prohibited by this chapter or violates any of the provisions of this chapter shall be liable to the city for all costs of testing, containment, cleanup, abatement, removal, disposal, and any other related costs or expenses that the city may incur in connection with the enforcement of this chapter and/or the prohibition and/or correction of a violation of this chapter and/or the abatement of any illicit discharge to the storm sewer system.

Additionally, the City of Roanoke has the authority to curb PCBs through soil movement reduction during construction on projects equal to or greater than 2500 SF as per Chapter 11.7-6 - Erosion and Sediment Control. The required City's VSMP E&S plan shall detail those methods and techniques to be used in the control of erosion and sediment.

Permits are required for demolition activities under Sec. 30-6. - Permits and liability insurance for certain work over public property in connection with construction, demolition or similar operations on private property.

In the Amendment Section 12-18 under the Fire Prevention Code, Section 307.1.2 Prohibits open burning. No person shall ignite or maintain, or cause or permit to be ignited or maintained, any open fire on public or private property outside any building. Salvage, demolition operations or disposal of waste materials by burning is prohibited.

BACKGROUND

Historical "Legacy" PCB Loading Sources

PCBs are man-made chemicals that were commonly marketed in the US under the name Aroclor by Monsanto and Pyranol by General Electric (OR DEQ, 2003). PCBs are either in an oily liquid or solid form; colorless or light yellow in color; and with no known taste or smell. There are 209 individual compounds, or congeners, that are considered under the term PCB. Each congener is represented by a four-digit number code; the first two digits indicate the parent molecule as a biphenyl. The difference between the 209 congeners is the number and position, or configuration of the chlorine atoms in the molecule. Therefore, the term PCB simply refers to any one of many congeners with a biphenyl root structure bonded to multiple chlorine atoms. These structures are extremely stable and resistant to degradation, properties which account for widespread use of PCBs historically as well as their continued presence in today's environment.

It has been estimated that nearly 1.7 million metric tons of PCBs were made worldwide between 1929 and 1989 (Grossman, 2013). In 1979, it became illegal to manufacture, distribute or use PCBs. PCBs were once found in the following product types: capacitors, transformers, plasticizers, surface coatings, inks, adhesives, pesticide extenders, paints, and carbonless duplicating paper (Tetra Tech, 2009). Most legacy PCB environmental loadings have been from point source contributions, spills, and releases (Tetra Tech, 2009). PCBs were once released via sewers, smokestacks, stormwater runoff, spills, and direct application to land for dust control and as a pesticide residue extender (OR DEQ, 2003). According to the Agency for Toxic Substances and Disease Registry (as cited in OR DEQ, 2003), massive amounts of PCBs have entered the environment through burning PCB-containing products, volatilization of paint and coatings, releases into surface waters and sewers, and improper PCB disposal in landfills and ocean dumping.

Point sources are now permitted and controlled through the National Pollutant Discharge Elimination System (NPDES) program, which was part of the 1987 amendments to the Clean Water Act. However, contamination can and does occur by the discharge of historical PCB loads as non-point source pollution resulting from runoff that flows over PCB contaminated soils. Due to PCBs widespread historical uses plus their stable molecular structure, PCBs are now found in the water, sediment, soil, and air in background concentrations. Sediment is a particular problem for some PCB congeners; hydrophobic PCB molecules attach to sediment particles, which settle on the bottom and could remain in streams, rivers and other surface water bodies indefinitely.

However, some PCB congeners are volatile enough, especially those congeners with 0-8 chlorine atoms, that they do vaporize from soil and water, thus releasing historical loadings of PCBs into the air. The airborne PCBs can travel on air currents and become redeposited during precipitation or air settling. This process is continuous and it is estimated that there are 1000 tons of PCBs in this atmospheric/deposition cycle over the United States (Hazardous Substance Data Bank as cited in OR DEQ, 2003). Temperatures appear to promote PCB volatility; therefore, greater atmospheric fluxes of PCBs tend to occur in warmer months (HSS, 2000). Biphenyls with 0-1 chlorine atom(s) remain airborne in the atmosphere, PCBs with 1-4 chlorine atom(s) migrate towards the poles by volatilization and deposition cycles, PCB congeners with 4-8 chlorine atoms stay in the middle latitudes, and congeners with 8-9 chlorine atoms stay close to the original PCB source (HHS, 2000). PCBs in a volatile state become deposited on terrestrial vegetation (HHS, 2000) as well as other urban surfaces.

PCBs were commonly used in construction materials in buildings that were built or renovated between 1950 and 1979. Potential sources of PCBs from that era include caulking used in windows, door frames, building joints, masonry columns, and other masonry materials (EPA, 2015). Additional building materials that may contain PCBs are: paints, mastics and other adhesives, fireproofing materials, ceiling tiles and acoustic boards, high intensity discharge lamp ballast capacitors and capacitors of fluorescent light ballasts, window glazing, spray-on fireproofing, and floor finishes (EPA, 2015). Light fixtures from that era can release PCBs into the air with normal use or if the ballast in the fixture breaks (EPA, 2015). PCB-source building materials can contaminate adjoining contact surfaces as well as the building's air. Building occupants can be exposed to PCBs through off gassing and direct dermal contact of PCB containing construction materials from that era. Outdoor soil and air contamination can result from older exterior caulk, paints, and coatings when they are exposed to the elements.

Non-Legacy Loading Sources

Although PCBs were banned from manufacturing, processing, distribution, and use, PCBs are still made inadvertently in certain manufacturing processes. These non-legacy PCBs are made as a by-product when hydrocarbons, chlorine, salts, and chlorinated hydrocarbons are combined under high temperatures. Products that can contain inadvertently made PCBs are those containing or incorporating pigments, paints, inks, and dyes. Examples of such products are clothing, newspapers, magazines, cardboard boxes, food wrappers, cosmetics, colored leather, colored plastics, indoor and outdoor residential and commercial paints and color-printed paper. Under TSCA, these products are allowed to contain PCBs in amounts up to 50 ppm, although a product's average is only allowed to be 25 ppm. According to Grossman (2013) 250 million metric tons of pigments were produced worldwide in 2006 alone. Most printing inks contain about 40% of pigment (Grossman, 2013). Rodenberg (2012) makes the case that there is a notable discrepancy between inadvertently made PCBs and water quality criteria. In fact, the pigment from one cereal box can contaminate about 2,000 L of water at the water quality standard (WQS) of 64 pg/L (640ppq) (Rodenberg, 2012).

These non-legacy sources, or inadvertently made PCBs are being identified throughout the United States, showing up in stormwater, wastewater, sediments, and air in addition to existing legacy sources. PCB 11, 206, 208, 209 are the most common non-legacy PCB congeners and are becoming markers for inadvertently made PCBs. PCB 11 is neither a historically produced congener, nor found as a breakdown product of the historical PCBs; therefore it is a result of current environmental loading (Grossman, 2013). PCB 11 is known to be inadvertently created during diarylide yellow pigment production (Grossman, 2013). Azo and diarylide pigments create mostly yellows but can also be used in orange and red pigment production. Phthalocyanine pigments are used to create blue and green products. Titanium dioxide production can also be a source of non-legacy PCBs (Grossman, 2013).

Chemicals with fewer chlorine atoms, like PCB 11 are more volatile for release into the air from pigments, paints, and inks (Grossman, 2013). In contrast, heavier pigments like the phthalocyanine-based blue and green pigments have more chlorinated atoms and are less likely to volatize and more likely to adhere to the product (Grossman, 2013). Adding more chlorine atoms creates additional molecular stability and therefore more lasting environmental effects (Hesselgrave, 2016).

BIOLOGICAL IMPLICATIONS

Each congener interacts uniquely with the environment and living organisms (Grossman, 2013). Exposure to PCBs, even at very low concentrations, measured in micrograms/kg or ppb, can have consequences on biological systems, particularly those that regulate metabolism, hormones and development (Zoeller as cited in Grossman, 2013). PCBs are very slow to break down in the environment and therefore persist long after they were created and deposited in the environment. The additional danger is that PCBs bioaccummulate in organisms because they are fat soluble or lipophilic (Grossman, 2013). These two factors allow PCBs to migrate up the food chain, making them considerably more dangerous for larger aquatic organisms, birds of prey, and mammals, including humans.

There are several surface waters in the Upper Roanoke River Watershed that are impaired for PCB contamination which is monitored in fish tissue and sediment samples. For this reason, the Virginia Department of Health (VDH) has issued fish consumption advisories for several sections of the Roanoke River and affected tributaries since 1988 (Tetra Tech, 2009).

The following chart shows impaired waterbodies, specific to the City of Roanoke and the required pollution reductions from point and non-point sources of PCBs to meet the reduction percentage. Waste load allocations for MS4s are based on estimates of upland soil tPCB concentrations (Tetra Tech, 2009). This WLA does not reflect a Margin of Safety (MOS).

PCB Impaired Segments with City of Roanoke MS4 WLA

Waterbody	Impaired Segment Description	Responsible Jurisdiction	Miles	Initial Listing Date	City of Roanoke Baseline (mg/yr)	City of Roanoke Waste Load Allocation (WLA) (mg/yr)*no MOS	% Reduction
Roanoke River	Mason Creek confluence – Back Creek Mouth	City of Salem, City of Roanoke	15.47	1996	84,565.4	94.7	99.89
Peters Creek	Peters Creek headwaters – Roanoke River Confluence	Roanoke County, City of Roanoke	7.17	2004	1033.7	9.8	99.05
Tinker Creek	Deer Branch (Carvin Creek) Confluence – Roanoke River Confluence	Roanoke County, City of Roanoke	5.35	2006	5081.3	48.3	99.05
Masons Creek	Not 303(d) listed	Roanoke County, City of Salem, City of Roanoke	N/A	N/A	14.6	0.1	99.05

Wolf Creek	Not 303(d) listed	Roanoke County	N/A	N/A	0.0	0.0	0.0

PCB REGULATORY SITE GUIDANCE OVERVIEW

PCB contaminated property can be transferred or sold. However, the property ownership exchange is not a release of obligations of either party regarding proper handling, cleanup, or disposal of contaminated material (EPA, 2005). "The responsibility for the initial PCB contamination (e.g., spill or other release) resides with the person(s) who caused the contamination or who owned or operated the PCBs or PCB-containing equipment at the time of the contamination. However, after the property transfer, the new owner becomes responsible for controlling and mitigating any continuing and/or future releases of PCBs" (EPA, 2005).

Under Section 6(e)(2)(A) of TSCA, continued use of the property may be prohibited as use of the property constitutes use of the PCBs on it. The owner of the PCB-contaminated property must comply with applicable use authorizations (i.e. intended land use and type of PCB waste); thus in most cases, the owner must clean up the property prior to use (EPA, 2005).

The following is a general accounting of how EPA regulates contaminated property. Please note there is considerably more detail in the source document, EPA (2005), *Polychlorinated Biphenyl (PCB) Site Revitalization Guidance under the Toxic Substances Control Act (TSCA)* outlining environmental cleanup and the following summary should not be considered all inclusive.

The allowable threshold for water containing PCBs that is discharged to a treatment works or surface waters is less than 3 micrograms/L (~3 ppb). This is also the limit under a permit issued under 402 of the Clean Water Act. Lastly releases for unrestricted use must be less than or equal to 0.5 micrograms/L (less than or equal to 0.5 ppb or 500,000 ppq) (EPA, 2005).The allowable threshold for inadvertently made PCBs in manufacturing products is up to 50 ppm, if the product's annual average in less than 25 ppm (TSCA). Given the two thresholds above, there is a significant disconnect with the Virginia water quality criterion of only 0.00000064 ppm*. As stated in the section on Non-Legacy PCB Sources, the pigment from one cereal box can contaminate about 2,000 L of water at the WQS of 64 pg/L (640ppq) (Rodenberg, 2012). Current PCB loadings created by inadvertent PCB production will pose challenges in meeting the water quality criteria of 6.4×10^{-7} ppm (0.00000064 ppm) and thus these sources, due to their ability to move are relevant to the City of Roanoke meeting our WLA.

*The following are equivalent units of measurement frequently used in reference to PCB levels: 0.00000064 ppm = 6.4×10^{-7} ppm = 64pg/L = 640 ppq.

EMERGING RESEARCH FOR CLEAN UP STRATEGIES

The information outlined in this section is being used as a planning tool as the city looks to lower/resolve impairments to achieve waste load allocations (WLA). The City recognizes the importance of collaborative partnerships to solving the environmental challenges in the Upper

Roanoke River Watershed. The programs outlined below are excellent opportunities to partner with local entities that are concurrently working on PCB Pollution Reduction Plans.

PCB Remediation through Anaerobic and Aerobic Bacteria

Promising research is being conducted at the University of Maryland in the labs of Dr. Kevin Sowers at the Institute of Marine and Environmental Technology and Dr. Upal Ghosh in the Chemical, Biochemical, & Environmental Engineering Department at UMBC. Granulated activated carbon (GAC) has been shown to sequester PCBs that are bioavailable to benthic organisms. Additionally, when GAC is seeded with specific anaerobic and aerobic bacteria, impressive PCB degradation occurs. In research led by Payne et al., (2013), GAC was seeded with anaerobic halorespiring *Dehalobium chlorocoercia* DF1 and aerobic *Burkholderia xenovorans* LB400. The anaerobic bacteria acts to dechlorinate congeners leaving the PCBs vulnerable to further degradation by aerobic bacteria through aromatic ring cleavage or biphenyl degradation (Payne et al., 2013). Experiment results showed an 80% PCB mass reduction within 120 days (Payne et al., 2013).

Locally, the Town of Alta Vista has been a part of Payne's research with a project involving the town's wastewater overflow pond. This type of research is favorable for a localized collaborative effort for legacy sources of sediment in tributaries and/or the Roanoke River as the research results indicate GAC bioaugmentation is more sustainable and lower cost approach to dredging.

Phytoremediation

The selective planting of trees and other vegetation to absorb and bind contaminants of concern is known as phytoremediation. When properly planned, phytoremediation can be a potentially viable option for PCB degradation. Research by Smith et al., (2007) found that high levels of organic amendment, initiating dechlorination, coupled with low-rate transpiring plants provided optimal reducing conditions. Work by Leigh et al., (2006) resulted in finding plants that produced secondary metabolites, such as terpenoids, phenols, resin acids and tannins with structures similar to PCBs attracting optimal microbial species that could degrade PCBs. Top culturable bacterial species were *Rhodococcus*, *Luteibacter* and *Williamsia* (Leigh et al., 2006). Genetic modification of plant species with introduced bacterial material (*Burkolderia xenovorans*) can produce enzymes to start PCB degradation and further stimulate the necessary microorganisms to complete the process (Mohammadi et al., 2007).

Other Strategies for Clean-up

Mechanical or vacuum dredging is an option for hot spot locations although this method is detrimental to the local environment. Dredging may add additional PCBs to the water column due to the disturbance of sediment which can facilitate PCB migration downstream. Since PCBs are hydrophobic, they form a strong relationship to fine sediments. The PCB/Sediment adsorption relationship is proportional to the TSS concentration, sediment organic content, and chlorination extent (i.e. congener number) of PCBs (Tetra Tech, 2009).

Source tracking through identification, mapping, and monitoring can be a valuable tool in the strategic deployment of both PCB assessment and remediation measures.

Atmospheric deposition has been shown to be a significant pathway of PCB cycling in freshwater systems (Tetra Tech, 2009). According to the Chesapeake Bay Program Atmospheric Deposition 1999 Study, the urban deposition rate is 16.3 micrograms/ m^2/yr (Tetra Tech, 2009). Partnering with or supporting the Greater Roanoke Valley Asthma and Air Quality Coalition and/or facilitating with Carilion or a Public Health graduate student to conduct atmospheric deposition studies may yield understanding of local atmospheric contributions of PCBs, assess volatility and levels of legacy and non-legacy PCBs in Roanoke Valley air and identify pathways and needed site remediation for contaminated sites.

PCB Monitoring Program

Waste load allocations (WLA) for MS4s are based on estimates of upland soil total PCB (tPCB) concentrations (Tetra Tech, 2009). PCB load reductions of 94.2%, 77.7%, and 76% in Peters Creek, Tinker Creek, and the upper Roanoke River respectively will be necessary to meet the City's TMDL WLA. Monitoring will be the City's primary method of TMDL Action Plan assessment. EPA Method 1668 is the preferred technique for accessing low levels of PCB congeners and will be used for the identification of the 119 most commonly found congeners. Additionally, the analysis will target 12 PCBs that have dioxin-like characteristics.

Since bioaccumulation in the food web is the most pressing human concern, studying the levels of PCBs that are bioavailable in the water column and what may be released from the stream sediment are the primary priorities for the City of Roanoke. Therefore, the City is partnering with Dr. Upal Ghosh's lab at UMBC to track and further identify specific PCB hotspots that serve as dominant sources of PCBs in the water column.

Monitoring will use passive sampling methodology to measure dissolved concentrations of PCBs and enable tracking of potential sources within the watersheds. The passive sampling polyethylene devices will be deployed in different phases such as air, sediment, and the water column at 22 different sites that will allow for a more comprehensive understanding of PCB movement and transport in the Roanoke River and the impaired tributaries. The 22 sites were chosen based on a risk analysis including historical land use and potential legacy PCB contamination. Other relevant risk factors that were qualitatively assessed include: soil type and erodibility factor, land surface slope, receiving public and private BMPs, areas of associated impervious surfaces (which may amplify instream soil erosion of suspected PCB containing soils), and hydraulic connectivity to the nearest stream and/or the City's stormdrain system. Table 1 in the Monitoring Schedule section summarizes the proposed locations and types of monitoring that will be performed.

Samples of 10-20 of the most frequently used municipal products will also be tested by the UMBC lab for inadvertently made PCBs.

TMDL ACTION PLAN OUTLINE

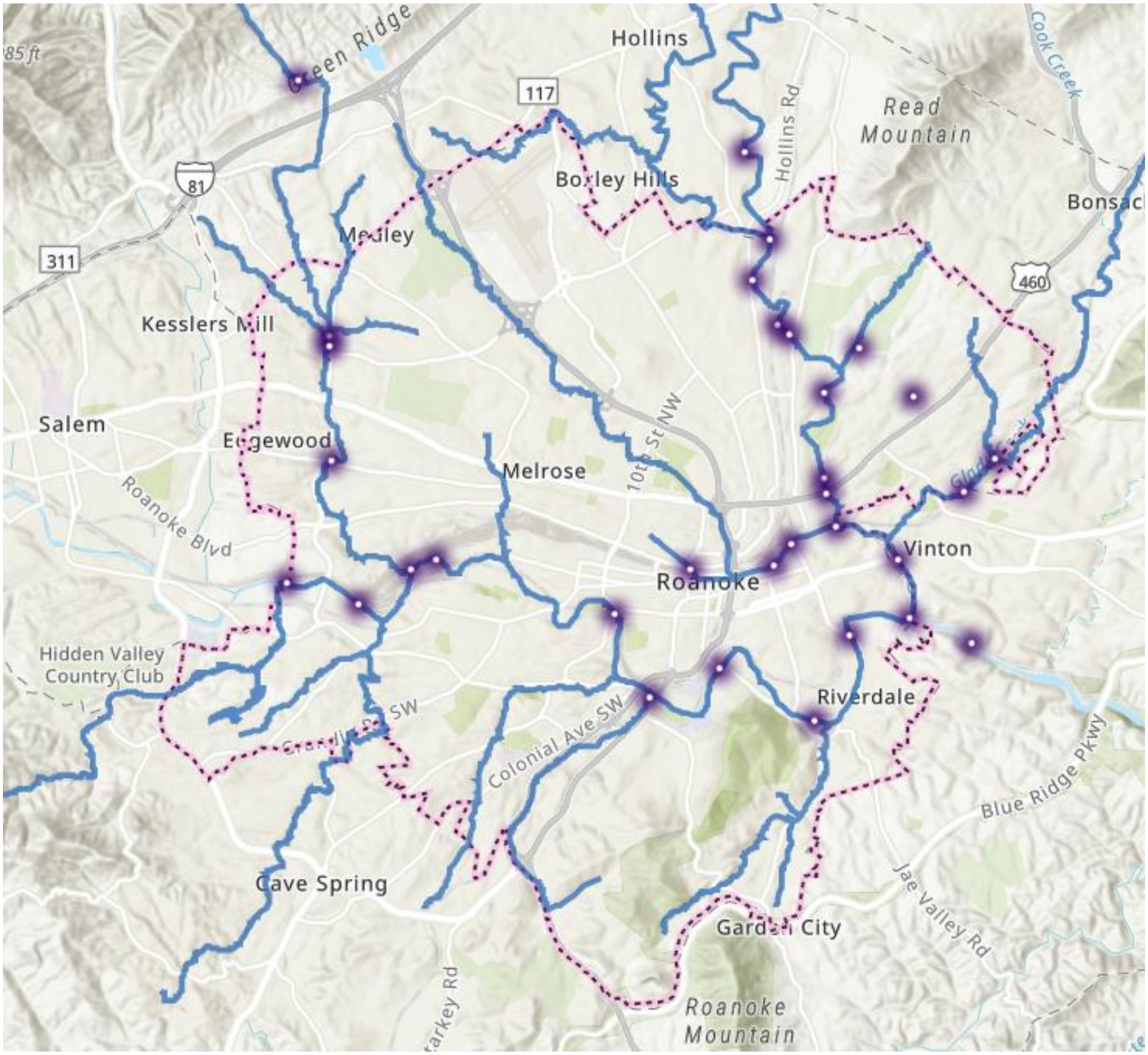
MONITORING SCHEDULE

- FY 2020 – Stormwater staff identified 22 PCB monitoring sites in Tinker Creek, Peters Creek, and the Roanoke River based upon risk map and potential current loading as well as legacy sites. These sites will be sampled starting in the spring 2020 for a duration of two months.

TABLE 1: SUMMARY TABLE OF PROPOSED LOCATIONS AND ANALYSIS PERFORMED. PRESENCE OF USGS GAGE AT OR NEAR SAMPLING LOCATION HIGHLIGHTED IN YELLOW.

Location ID	River/Stream	Water sampler	Porewater sampler	Air sampler	Sediment grab	DOC	TSS	POC
TC-0	Tinker Creek	X	X					
TC-1	Tinker Creek	X	X					
TC-2	Tinker Creek	X	X					
TC-3	Tinker Creek	X	X					
TC-4	Tinker Creek				X			
TC-5	Tinker Creek				X			
TC-6	Tinker Creek	X	X					
TC-7	Tinker Creek	X	X					
TC-8	Tinker Creek	X	X					
TC-9	Tinker Creek	X	X			X	X	X
GC-1	Glade Creek	X	X			X	X	X
LR-1	Lick Run	X				X	X	X
TR-1	Trout Run				X			
PC-0	Peters Creek	X	X					
PC-1	Peters Creek	X	X					
PC-2	Peters Creek	X	X					
PC-3	Peters Creek	X	X			X	X	X
RR-1	Roanoke River	X	X	X				
RR-2	Roanoke River	X	X					
RR-3	Roanoke River	X	X					
RR-4	Roanoke River	X	X					
RR-5	Roanoke River	X	X					
RR-6	Roanoke River	X	X	X		X	X	X
RR-7	Roanoke River	X	X		X			
OB-1	Ore Branch	X	X	X	X	X	X	X
Total sampling locations		**22**	**21**	**3**	**5**	**6**	**6**	**6**

FIGURE 1: MAP OF PROPOSED MONITORING LOCATIONS AS OUTLINED IN TABLE 1



- FY 2021 – UMBC will collect passive samplers and provide laboratory analysis including the following objectives:
    - Determine whether legacy bed sediments are the dominant source of PCBs in the water column by using the flux estimations between sediment porewater concentrations and surface water.
    - Calculate the total PCB loading including dissolved and suspended loads from Peters Creek, Tinker Creek, and the Roanoke River.
    - Measure PCBs in sediment at various locations to determine whether ongoing sediment inputs are providing ongoing contamination or providing cover (beneficial clean-up) for legacy sediments.
    - Determine whether the air phase acts as a source or a sink for PCBs.
    - Calculate PCB loads and total PCB loads (g/year)
    - Determine any unique congener fingerprints that can be associated with a specific industry/activity type.
    - Four locations will be analyzed for organochlorine pesticides (OCP) and polyaromatic hydrocarbons (PAH) in Tinker Creek and the Roanoke River.

EDUCATION AND OUTREACH

- FY 18-23 PCB webpage content
    - General public education can be found on the PCB webpage outlining PCB characteristics, impaired locations, potential health implications, fish consumption advisories including information on non-legacy PCB containing products.
    - Increase knowledge of inadvertently made PCBs and actions that can be taken to reduce those products' uses or replace the PCB-containing product with one that has fewer or no PCBs.

- FY 20-23 Annual Publication of the State of the Waters – PCB specific information on page 7. In FY 2020, the publication was mailed to 32,454 Stormwater Utility customers as well as 1546 hardcopies available in libraries and for handouts as needed. Monitoring findings will be part of the publication annually as well as future City actions.

- PCB brochures
    - FY 20 and FY 22 Biennially mailed to 1745 businesses that include contractors, autobody/repair shops, painting, salvage yards, and other similar businesses.
    - FY 18-23 - Brochures will be available for handout at outreach events, presentations, at the lobby kiosk in Noel C. Taylor Municipal Building, and for citizens applying for building demolition permits.

- Presentations
    - FY 20 and FY22 Biennial staff training on PCBs during safety meetings.
    - FY 18-23 PCBs including those found in consumer products has been included in stormwater presentations to the community.

CITY OF ROANOKE

- Comprehensive identification of city-owned properties that may be PCB sources based on historical land use:

TABLE 2: LOCATION OF POTENTIAL PCB SOURCES ON CITY-OWNED PROPERTY

CITY OWNED LOCATION	LAND USE TYPE	SOURCE TYPE
210 RESERVE AVE SW	River's Edge Sports Complex	Suspected Legacy
1610 BURRELL ST NW	Washington Park (old landfill)	Suspected Legacy
502 19TH ST SE	Fallon Park (old landfill)	Suspected Legacy
13TH ST NE	East Gate Park (old landfill)	Suspected Legacy
0 RAILROAD AVE SW	Benchcut	Suspected Legacy
0 RAILROAD AVE SW	Benchcut	Suspected Legacy
0 RAILROAD AVE SW	Benchcut	Suspected Legacy
0 RAILROAD AVE SW	Benchcut	Suspected Legacy
0 13TH ST NE	Benchcut	Suspected Legacy
0 NORTH AV NE	Benchcut	Suspected Legacy
0 13TH ST NE	Benchcut	Suspected Legacy
0 NORTH AV NE	Benchcut	Suspected Legacy
0 RIVERDALE RD SE	Benchcut	Suspected Legacy
0 RIVERLAND RD SE	Benchcut	Suspected Legacy
1324 RIVERLAND RD SE	Benchcut	Suspected Legacy
0 BENNINGTON ST SE	Benchcut	Suspected Legacy
0 PROGRESS DR SE	Benchcut	Suspected Legacy
1802 Courtland Road SW	Public Works Service Center	Inadvertently-made PCBs from products

- During the last MS4 permit cycle a City of Roanoke Municipal Operations PCB Risk Summary Report was created for products and vehicles.
    - Table 3 includes an updated list of the most frequently used municipal products that may come in contact with precipitation as a result of daily work activities. If

products contacting stormwater are found to contain high levels of inadvertently made PCBs, equally performing alternative products may be sourced.

TABLE 3: CITY OF ROANOKE MUNICIPAL PRODUCTS

State	Product Type	Brand	Departments
liquid	Herbicide	Roundup QuikPRO	Transportation, Stormwater, Parks
liquid	Pre-Emergent	Prodiamine	Parks
liquid	Herbicide	Triplett	Transportation
liquid	Herbicide	Aqua Neat Aquatic (glyphosate)	Stormwater
liquid	Antifreeze (green)	Zerex Green	Fleet
liquid	Antifreeze (gold)	Zerex Gold	Fleet
liquid vs. dry	Road Paint (white)	Ennis White Traffic Paint	Transportation
liquid vs. dry	Road Paint (yellow)	Ennis Yellow Traffic Paint	Transportation
solid	Road - crosswalks, arrows	Yellow Flint Trading Preform Thermo Plastic	Transportation
solid	Road - crosswalks, arrows	White Flint Trading Preform Thermo Plastic	Transportation
solid	Crack Sealer	Crack Master	Stormwater
liquid	Motor Oil	Mobile One	Fleet
liquid	Hydraulic Fluid	Bulk from Hutchen's Petroleum	Fleet
liquid	Marking paint	Rust-oleum and Krylon Industrial	Transportation, Stormwater, Parks
liquid	Tracer Dye	RoCan and Trace-A-Leak	Parks, Stormwater
liquid	Hand Soap	Inofoam Antibacterial Handsoap	Facilities
liquid	Water stop cement	Oatey	Stormwater
solid	Emulsified Asphalt or CRS-2H Normal	Asphalt Emulsion CRS-2H	Transportation
solid	Joint and Termination Sealant	JTS1 - Mulehide	Facilities
liquid	HVAC Coil Cleaner	Nu-Calgon	Facilities

Sources:

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